CLAIMS

1. An apparatus comprising:

a first generation comprising at least two first generation channels;

a common channel providing communication between each of the at least two first generation channels; and

a second generation comprising at least three second generation channels, each second generation channel having a first end and a second end, the first end of each being in communication with the common channel.

2. The apparatus of claim 1 wherein all channels within a generation can provide approximately equal resistance to fluid flow.

3. The apparatus of claim 1 wherein at least one of the channels is in communication with a valve.

4. The apparatus of claim 1 wherein at least a portion of a first generation channel is less than about 1 mm wide.

5. The apparatus of claim 4 wherein at least a portion of a first generation channel is less than about 100 μm wide.

6. The apparatus of claim 5 wherein at least a portion of a first generation channel is less than about 50 μm wide.

7. The apparatus of claim 1 wherein all of the channels are less than 1 mm wide.

8. The apparatus of claim 1 wherein the second generation comprises at least one channel more than the first generation.

9. The apparatus of claim 1 further comprising a third generation, the third generation comprising at least one channel more than the second generation, each third

generation channel having a first end and a second end, the first end of each being in communication with the second end of each of the second generation channels.

10. The apparatus of claim 1 wherein the second end of each second generation channel is in communication with the other second generation channels.

11. The apparatus of claim 9 further comprising additional generations wherein each successive generation comprises one more channel than does an immediately preceding generation.

12. The apparatus of claim 1 wherein the first ends of each of two adjacent second generation channels are about equidistant from one of the first generation channels.

13. The apparatus of claim 1 wherein the second generation channels are convoluted.

14. The apparatus of claim 1 wherein the common channel can provide less resistance to flow than can the first and second generation channels.

15. The apparatus of claim 1 wherein at least two of the second generation channels are in fluid communication with separate receiving vessels.

16. The apparatus of claim 15 wherein all of the second generation channels are in fluid communication with separate receiving vessels.

17. The apparatus of claim 1 comprising a second common channel, the second common channel in fluid communication with the second end of at least one of the second generation channels.

18. The apparatus of claim 17 wherein the width of the second common channel varies over at least a portion of a length of the second common channel.

19. The apparatus of claim 9 comprising a composite channel, the composite channel being in fluid communication with the second end of at least one of the third generation channels.

20. The apparatus of claim 11 comprising a composite channel, the composite channel being in fluid communication with the second end of at least one of a final generation channel.

21. The apparatus of claim 20 wherein all of the final generation channels are in fluid communication with the composite channel.

22. A network comprising two or more of the apparatus of claim 1.

23. A method of forming a gradient comprising:

passing a first fluid through a first channel;

passing a second fluid through a second channel;

joining the first fluid and the second fluid in a common channel;

passing fluid from the common channel into at least three additional channels; and

recombining the fluid from the three additional channels into a single channel under conditions of substantially laminar flow to produce a composite fluid.

24. The method of 23 wherein the fluid is a liquid.

25. The method of claim 23 wherein the fluid is a gas.

26. The method of claim 23 further comprising passing at least the first fluid through additional channels in additional stages.

27. The method of claim 23 further comprising the step of dividing the recombined fluid into four additional channels.

28. The method of claim 23 further comprising passing a third fluid through a third channel and joining the third fluid with the first and second fluids in the common channel.

29. The method of claim 23 further comprising the step of adjusting the rate of flow of at least the first fluid.

30. The method of claim 23 further comprising the step of smoothing the gradient profile in the recombined fluid.

31. The method of claim 30 further comprising the step of allowing substantial diffusion to occur between laminarly flowing streams in the recombined fluid.

32. The method of claim 31 further comprising the step of altering the amount of diffusion by altering the velocity of the flow of at least the first fluid.

33. A fluid stream comprising:

a first substance that varies in concentration in a direction substantially perpendicular to the direction of flow of the fluid;

a second substance that varies in concentration in a direction substantially perpendicular to the direction of flow of the fluid; and

a concentration gradient of the first substance being of a different profile than a concentration gradient of the second substance.

34. The fluid stream of claim 33 wherein the fluid is a liquid.

35. The fluid stream of claim 33 wherein the fluid is a gas.

36. The fluid stream of claim 33 wherein a profile representing the concentration gradient of the first substance can be represented by a second order or higher polynomial.

37. The fluid stream of claim 33 further comprising a third substance, the concentration of the third substance varying in concentration in a direction substantially perpendicular to the direction of flow.

38. The fluid stream of claim 34 wherein the substance is a biochemical.

39. The fluid stream of claim 38 wherein the biochemical is a peptide.

40. An nth order polynomial concentration gradient wherein n is greater than or equal to 2.

41. The concentration gradient of claim 40 wherein the width across the gradient is less than 1 cm.

42. The concentration gradient of claim 41 wherein the width across the gradient is less than 1 mm.

43. The concentration gradient of claim of claim 40 wherein the gradient is in a fluid and is stable for at least about 10 seconds.

44. The concentration gradient of claim 40 wherein the gradient is on a surface.

45. The concentration gradient of claim 44 wherein the gradient is a chemical or biochemical gradient.

46. The concentration gradient of claim 45 wherein the gradient is less than about 1 cm in width.

47. The concentration gradient of claim 46 wherein the gradient is less than about 1 mm in width.

48. The surface of claim 46 wherein the surface is a protein chip.

49. A surface comprising:

a first chemical or biochemical gradient disposed on a portion of the surface;

a second chemical or biochemical gradient disposed on the portion of the surface; and

a third chemical or biochemical gradient disposed on the portion of the surface, wherein each gradient is different.

50. The surface of claim 49 wherein the width of at least one of the gradients is less than about 1 mm.

51. The surface of claim 49 wherein the surface is a protein chip and at least one of the chemical or biochemical is a peptide.

52. The surface of claim 49 wherein at least the first chemical or biochemical is embedded in a matrix.

53. The surface of claim 51 wherein the matrix is a gel.

54. A method of treating a surface comprising:

passing a fluid along a portion of a surface under conditions of substantially laminar flow wherein the fluid comprises a concentration gradient of at least one substance, the concentration gradient being substantially perpendicular to the direction of flow and being substantially continuous across the fluid; and

treating differentially a plurality of sections of the portion of the surface exposed to different concentrations of the substance.

55. The method of claim 54 wherein the portion of the surface is less than 10 cm wide.

56. The method of claim 55 wherein the portion of the surface is less than 1 cm wide.

57. The method of claim 56 wherein the portion of the surface is less than 1 mm wide.

58. The method of claim 54 wherein the substance is a catalyst.

59. The method of claim 54 wherein the treatment comprises hardening the surface.

60. The method of claim 54 wherein the treating comprises depositing the substance on the surface.

61. The method of claim 60 wherein the portion of the surface is less than 1 cm in width.

62. The method of claim 54 wherein the treating comprises forming a topological gradient on the surface.

63. The method of claim 62 wherein the treating comprises removing material from the surface.

64. The method of claim 63 wherein the portion of the surface is less than 1 cm in width.

65. A method of diluting a fluid comprising:

feeding a high concentration fluid to a first inlet;

feeding a low concentration fluid to a second inlet;

passing the fluid from the first inlet and the fluid from the second inlet into a first generation common channel;

splitting the fluid in the common channel into at least three second generation channels;

recombining the fluids from the at least three second generation channels into a second generation common channel;

splitting the fluid in the second generation common channel into a plurality of third generation channels; and

collecting fluid from at least one of the plurality of third generation channels.

66. A method of producing a fluid exhibiting two different concentration gradient profiles, the method comprising:

combining at least a first starting fluid with a second starting fluid to form a combined stream, the first starting fluid comprising a first substance that is substantially absent from the second fluid;

dividing the combined stream into a series of second stage streams; and

joining at least two of the second stage streams to form a composite stream wherein the composite stream exhibits a different concentration gradient profile for the first substance and a second substance.

67. A method of producing a series of solutions comprising:

contacting a concentrated solution of a substance and a less concentrated solution of the substance to form a combined fluid; and

separating the combined fluid, without using a membrane, into a plurality of separate streams wherein at least one of the separate streams comprises the substance at a concentration that is substantially different than the concentration of the substance in another of the separate streams.

68. The method of claim 67 wherein the concentration of the substance in one of the separate streams is about equal to the concentration of the substance in either the concentrated solution or the less concentrated solution.

69. The method of claim 67 further comprising the step of contacting a third solution comprising a second substance with the combined fluid.

70. The method of claim 69 wherein at least one of the separate streams contains concentrations of the first substance and the second substance at a ratio that is different than the ratio of the first substance and the second substance in at least one other of the separate streams.